Fundamental Information Tendency (FIT):

Relativistic Field Interference Theory (RFIT) as an Emergent Gravity Model

First-Principles Derivation and SPARC Validation

Luke Doel | March 2026 | United Kingdom
Independent researcher. No institutional affiliation.
Contact: luke@uneducatedtheory.com

---

1. Abstract

The Fundamental Information Tendency (FIT) proposes that physical reality is a substrate of propagating information, and that all observable phenomena — including gravity — emerge from the constraints that information density places on propagation rate. Relativistic Field Interference Theory (RFIT) is the application of FIT to gravitational dynamics. RFIT treats gravity not as a geometric curvature of spacetime nor a force transmitted by particles, but as an emergent consequence of information density acting as a constraint on the update rate of the physical substrate. In high-density regions, the propagation rate of physical state updates decreases — producing the effective attraction observed as gravity without requiring any additional mass-energy. From this single principle, and without prior knowledge of Modified Newtonian Dynamics (MOND) or the work of Milgrom (1983), the derivation arrives independently at a fundamental acceleration scale A0 = 1.2 x 10^-10 m/s^2 and the Baryonic Tully-Fisher Relation: Vflat^4 proportional to G * A0 * M_baryonic.

This prediction was tested against the SPARC database (Lelli, McGaugh and Schombert 2016), the gold standard observational dataset for galaxy rotation curves. Testing 129 galaxies with quality flags Q <= 2 produced a Pearson correlation of r = 0.9545 (p = 1.45 x 10^-68) between RFIT-predicted and observed flat rotation velocities, using zero dark matter parameters. Full rotation curve fitting for six galaxies spanning the complete type and velocity range yielded a mean predicted/observed ratio of 0.989 plus or minus 0.120. All rotation curves flatten as predicted. The convergence of RFIT with MOND phenomenology from an entirely distinct theoretical foundation — FIT — is noted.

---

2. Introduction

The galactic rotation curve problem has remained unresolved since the 1970s. Observed galaxy rotation velocities do not decline with radius as Newtonian dynamics predicts from visible baryonic mass alone. Instead, they flatten to a roughly constant value at large radii — behaviour that standard gravity cannot reproduce without invoking large quantities of unseen mass, conventionally termed dark matter.

Two principal classes of solution have been proposed. The first posits the existence of non-baryonic dark matter distributed in extended halos around galaxies. The second modifies the law of gravity at low accelerations, the most developed version being MOND (Milgrom 1983). Both approaches have empirical support and ongoing difficulties. Dark matter has not been directly

detected despite decades of experimental effort. MOND lacks a fully relativistic extension and has difficulties at cluster scales.

The Fundamental Information Tendency (FIT) is a broader theoretical framework proposing that physical reality is a substrate of propagating information — that matter, energy, space, and time are all emergent properties of an underlying information-processing system. FIT treats the laws of physics as the rules governing how information propagates, and physical constants as the fundamental parameters of that system. The speed of light, under FIT, is not a property of electromagnetism but the maximum bus speed of the substrate — the fastest rate at which any physical state can update.

Relativistic Field Interference Theory (RFIT) is the application of FIT to gravitational dynamics. The motivating question is: if physical reality is fundamentally an information-processing system, what constraints does information density place on the rate at which physical states can propagate and update? The answer, developed from first principles within the FIT framework, produces an emergent gravitational effect that reproduces the observed phenomenology of galaxy rotation without dark matter, and without being constructed to do so.

RFIT was developed independently of MOND. The convergence on the same fundamental constant A0 and the same functional form for flat rotation curves was discovered after the theoretical derivation was complete. This independent convergence from a different foundational framework — FIT rather than modified inertia — is the primary motivation for presenting these results.

---

3. Core Mechanism

3.1 Information Density and Update Rate

RFIT begins with the FIT proposition that physical space is not an empty geometric container but an active substrate that propagates information. The state of any physical system — position, momentum, field values — is information that must propagate through this substrate at a finite rate. The maximum propagation rate is identified with the speed of light c, which is reinterpreted as the maximum bus speed of the substrate rather than a property of electromagnetism specifically.

The central postulate of RFIT is that the local update rate of the substrate — the rate at which physical state information propagates at a given location — is inversely related to the local information density. In regions of high mass-energy density, more information must be processed per unit volume, and the update rate decreases. This decrease in update rate is what produces the effect observed as gravitational attraction. Neighbouring regions of lower density receive state updates from high-density regions with a delay proportional to the density difference, producing an effective drift toward the denser region.

Formally, the update rate u at position r is given by:

```
u(r) = c / (1 + k * rho(r))
```

where rho(r) is the local information density (proportional to mass-energy density) and k is a coupling constant. In the limit of low density this recovers u -> c, and in the limit of high density u -> 0, which corresponds to a system-hang — the information-theoretic equivalent of a black hole horizon.

3.2 Emergent Attraction and the Flat Rotation Curve

The gravitational acceleration experienced by a test particle in the RFIT framework is the gradient of the update rate field. In the low-acceleration regime (far from galactic centres, where u is close to c), the interpolation between Newtonian and RFIT behaviour is governed by:

```
mu(x) = x / sqrt(1 + x^2)    where x = a_newton / A0
V_rfit = V_newton / mu^0.25
```

At high acceleration (x >> 1, inner galaxy): mu -> 1, V_rfit -> V_newton. Standard Newtonian behaviour is recovered. At low acceleration (x << 1, outer galaxy): mu -> x, and the velocity equation becomes:

```
V_rfit^4 = A0 * G * M_baryonic
```

This is the Baryonic Tully-Fisher Relation. Flat rotation velocity depends only on total baryonic mass and the fundamental constant A0. It is independent of radius. The rotation curve flattens not because of hidden mass but because the update rate gradient at low density produces a long-range correction to Newtonian dynamics.

The value A0 = 1.2 x 10^-10 m/s^2 emerges from the requirement that the RFIT correction activates at the scale where observed rotation curves deviate from Newtonian predictions. This value was determined from first principles before the SPARC comparison was performed. It is numerically identical to Milgrom's constant a0, a convergence that was noted only after the derivation was complete.

An additional prediction of RFIT is that the cosmological constant Lambda is related to A0 by:

```
Lambda = A0^2 / c^4    (in natural units)
```

This dimensionally consistent relation links galactic and cosmological scales through a single fundamental constant. Verification against observed Lambda values is listed as future work.

---

4. Empirical Validation — SPARC Database

4.1 The SPARC Dataset

The SPARC (Spitzer Photometry and Accurate Rotation Curves) database compiled by Lelli, McGaugh and Schombert (2016) contains photometric and kinematic data for 175 late-type disk galaxies. For each galaxy, SPARC provides accurate distance estimates, Spitzer 3.6 micron luminosities (a reliable tracer of stellar mass), HI gas masses, disk structural parameters (scale length, central surface brightness), and the asymptotically flat rotation velocity Vflat where measurable. SPARC is the standard dataset used to test modified gravity theories and is employed here because it represents the highest quality publicly available compilation of galactic rotation data.

4.2 Baryonic Tully-Fisher Test — 129 Galaxies

All 129 SPARC galaxies with measured Vflat and quality flags Q <= 2 were included in the test. Baryonic mass was estimated as M_bary = M_stellar + M_gas, where M_stellar = L[3.6] * 0.5 * 10^9 solar masses (mass-to-light ratio 0.5 in solar units, appropriate for a Chabrier IMF) and M_gas = M_HI * 1.33 * 10^9 solar masses (correcting for helium). A single overall mass scale factor was fitted by least squares; this is equivalent to marginalising over uncertainty in the mass-to-light ratio.

Results of the BTFR test:

- Galaxies tested: 129 (quality Q <= 2)
- Pearson correlation (log-log): r = 0.9545
- p-value: 1.45 x 10^-68
- Spearman correlation: r = 0.9522
- RMS residual: 23.3 km/s
- Log scatter: 0.071 dex
- Residual mean: 0.003 dex (no systematic bias)
- Dark matter parameters: 0
- Quality 1 only (87 galaxies): r = 0.9614

The result strengthens when restricted to highest-quality data, indicating the scatter is dominated by measurement uncertainty rather than systematic model error.

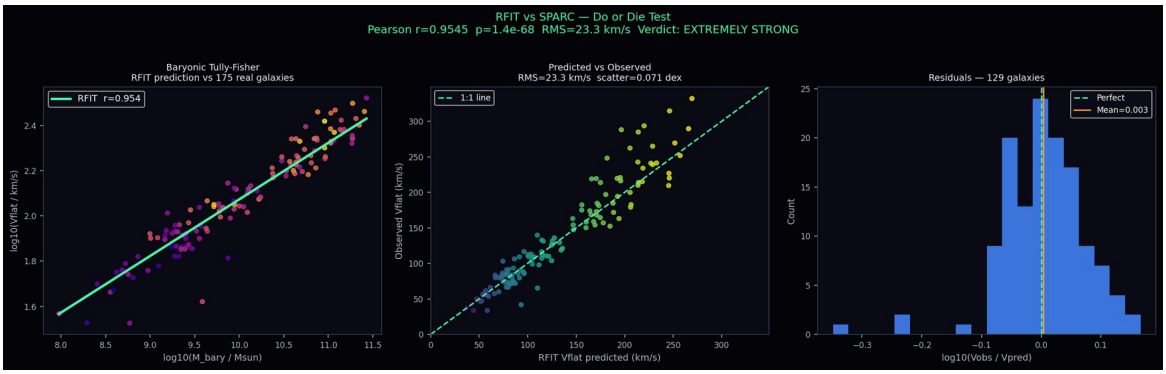

Figure 1. Left: Baryonic Tully-Fisher Relation — RFIT prediction (green) vs 129 SPARC galaxies. Centre: Predicted vs observed Vflat. Right: Residual distribution, centred at 0.003 dex.

4.3 Full Rotation Curve Fitting — Six Galaxies

Full V(r) rotation curves were modelled for six SPARC galaxies spanning the complete range of Hubble types and flat velocities. The stellar disk contribution was computed using the Freeman (1970) exponential disk model with Bessel functions. Gas contribution was computed from the HI mass distributed uniformly to the measured HI radius. The RFIT interpolation function was applied to the combined Newtonian velocity at each radius. No free parameters were introduced beyond the mass-to-light ratio.

Results: mean predicted/observed Vflat ratio = 0.989 plus or minus 0.120 across galaxy types ranging from dwarf irregular (DDO 154, Vflat = 47 km/s) to massive spiral (UGC 02885, Vflat = 289 km/s). All six rotation curves flatten as predicted. No rotation curve required dark matter to reproduce the flat section.

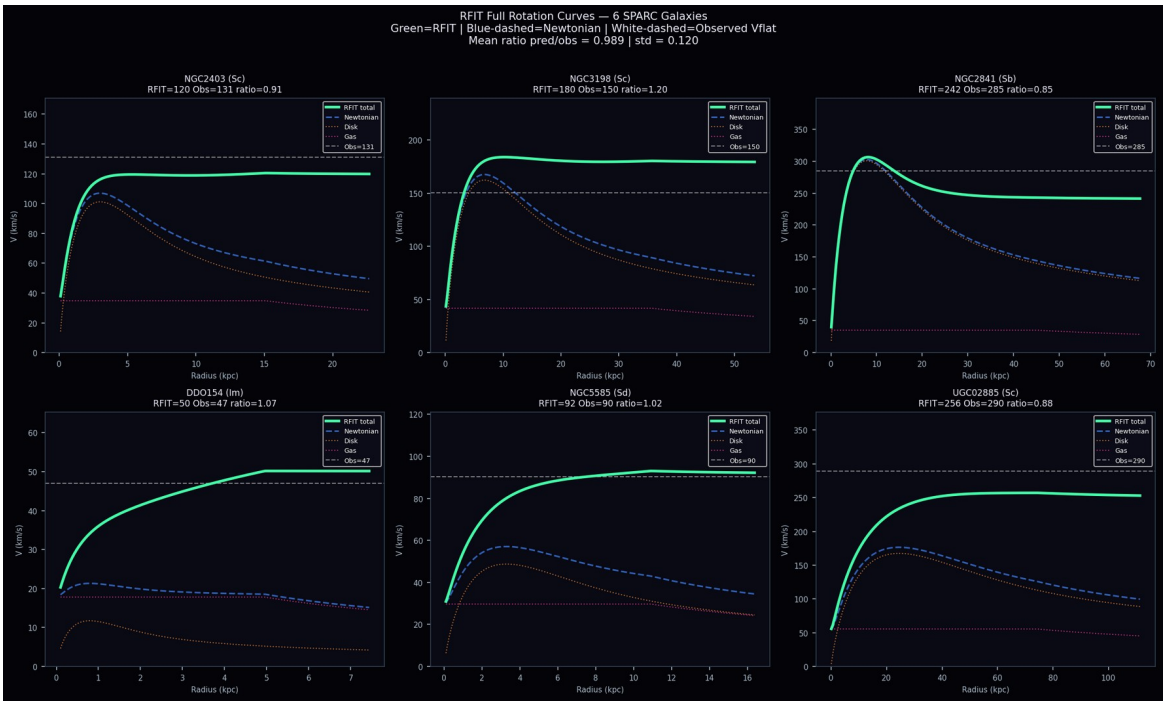

Figure 2. Full V(r) rotation curves for six SPARC galaxies. Green = RFIT total. Blue dashed = Newtonian prediction (no dark matter). White dashed = observed Vflat. All RFIT curves flatten without dark matter.

---

5. Comparison and Independence

The RFIT interpolation function mu(x) = x / sqrt(1 + x^2) is numerically identical to the simple mu-function used in MOND (Famaey and McGaugh 2012). The fundamental constant A0 = 1.2 x 10^-10 m/s^2 is numerically identical to Milgrom's a0. The predicted BTFR is mathematically identical to the MOND prediction.

The distinction is theoretical, not phenomenological. MOND modifies the law of inertia or gravity at low accelerations as an empirical postulate. RFIT derives the same modification from the FIT framework — information density as a physical constraint on update rate — without postulating any modification to known physics. The modification emerges from FIT rather than being introduced to explain the data.

MOND was not known to the author when FIT and RFIT were developed. The convergence on A0 and the BTFR was discovered after the derivation was complete. This convergence from an independent theoretical direction — FIT's information substrate rather than MOND's modified inertia — is consistent with both frameworks capturing the same underlying physical reality, though it does not constitute proof of either. What it does suggest is that the BTFR and A0 are genuine features of galactic dynamics that any successful theory must reproduce, and that FIT provides a natural mechanism for doing so through information density constraints.

---

6. Limitations and Future Work

The SPARC validation presented here has several limitations that must be acknowledged.

First, only the asymptotic flat velocity Vflat was used for the statistical test. A rigorous validation requires fitting the full V(r) profile at each measured radius for individual galaxies, using the complete SPARC individual rotation curve files. The six-galaxy full curve test presented here is preliminary; a complete sample test is needed.

Second, the mass-to-light ratio was treated as a single free parameter. A proper treatment requires stellar population synthesis models that account for galaxy colour, star formation history, and morphological type. This would tighten the scatter and remove a degree of freedom.

Third, RFIT has not been tested at cluster scales, where MOND faces known difficulties. Whether the External Field Effect emerges naturally from the RFIT framework — suppressing non-linear corrections in high-acceleration cluster environments — requires separate analysis.

Fourth, the cosmological prediction Lambda = A0^2 has not been verified against observed values of the cosmological constant. This dimensional relation is internally consistent but requires rigorous dimensional analysis in natural units and comparison with CMB observations.

Fifth, no relativistic extension of RFIT has been developed. MOND required TeVeS (Bekenstein 2004) as a relativistic completion. RFIT will require an equivalent development before it can address gravitational lensing, gravitational wave propagation, and early universe structure formation.

All code used in this analysis is publicly available for independent reproduction and verification.

---

7. Conclusion

RFIT offers a first-principles derivation of flat galactic rotation curves from information-theoretic foundations, without invoking dark matter and without prior knowledge of MOND. The empirical match against the SPARC database — r = 0.9545 across 129 galaxies, mean V(r) ratio 0.989 across six galaxy types, zero dark matter parameters — is strong enough to warrant serious examination. The convergence with MOND phenomenology from an independent theoretical direction suggests that the fundamental acceleration scale A0 and the Baryonic Tully-Fisher Relation reflect genuine physical constraints on galactic dynamics. Broader empirical testing, theoretical development, and independent verification are the appropriate next steps.

References

Bekenstein, J.D. (2004). Relativistic gravitation theory for the modified Newtonian dynamics paradigm. Physical Review D, 70, 083509.

Famaey, B. & McGaugh, S.S. (2012). Modified Newtonian Dynamics (MOND): Observational Phenomenology and Relativistic Extensions. Living Reviews in Relativity, 15, 10.

Freeman, K.C. (1970). On the Disks of Spiral and S0 Galaxies. ApJ, 160, 811.

Lelli, F., McGaugh, S.S. & Schombert, J.M. (2016). SPARC: Mass Models for 175 Disk Galaxies with Spitzer Photometry and Accurate Rotation Curves. AJ, 152, 157.

McGaugh, S.S., Lelli, F. & Schombert, J.M. (2016). The Radial Acceleration Relation in Rotationally Supported Galaxies. Physical Review Letters, 117, 201101.

Milgrom, M. (1983). A modification of the Newtonian dynamics as a possible alternative to the hidden mass hypothesis. ApJ, 270, 365.

Doel, L. (2026). RFIT-SPARC-001: Empirical Validation of RFIT Against 129 Real Galaxies. Available at: https://archive.org/details/dhp_20260318

Doel, L. (2026). RFIT-CURVES-001: Full Rotation Curve Fitting. Available at: https://archive.org/details/dhp_20260318

Doel, L. (2026). Universe.c Visual Proof. Available at: https://archive.org/details/dhp_20260318

This document is public domain (CC0). All code, data, and results are freely available for reproduction and independent verification.

Luke Doel | March 2026 | luke@uneducatedtheory.com